INDOOR AIR QUALITY ASSESSMENT

Devens Conference Center
100 Sherman Avenue
Devens, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
August 2003

Background/Introduction

At the request of Frauke Argyros, Massachusetts Department of Public Health (MDPH) Division of Food and Drug (DFD), the MDPH Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality at the Devens Conference Center (DCC), 199 Sherman Avenue, Devens, Massachusetts. Complaints from conference attendees of illness, as well as natural gas and mold odors prompted the request. On May 22, 2003, a visit was made to this building by Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Accompanying Mr. Feeney were Sharon Lee, Environmental Analyst, ER/IAQ Program, Charles Duval, Manager, Devens Department of Public Works and other staff from the MassDevelopment Finance Agency (MassDevelopment).

According to Ms. Argyros, the DFD conducted an investigation of an incident of possible foodborne illness in attendees at a conference held at the DCC on the weekend of May 17-18, 2003. After interviewing conference attendees, Ms. Argyros contacted BEHA to conduct an indoor air quality assessment of the DCC when the symptoms reported (nausea, headaches and dizziness) appeared to be potentially indoor air quality related. In addition, conference attendees reported that mold and gas odors existed in the dining room area during the conference.

The DCC was originally constructed as the Fort Devens Officers Club in 1986. The DCC is a one-story brick clad building. The DCC contains three dining/function rooms, one bar, a kitchen and offices. The kitchen was inactive during this assessment. Windows in a majority of the building are not openable.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551.

Results

The DCC has an employee population of five and was visited by approximately 80 individuals attending the conference at the time of the incident. Tests were taken during normal operations during the workday, however no conferences were in session at the time. Results appear in Table 1.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were below 800 parts per million of air (ppm) in all areas surveyed, which is indicative of adequate ventilation when the building is not hosting conferences. Please note that carbon dioxide levels would be expected to increase during conferences.

Air handling units (AHUs) provide fresh air. AHUs are located in mechanical rooms (see Picture 1). Fresh air in occupied spaces is supplied by ceiling mounted fresh air diffuser connected to AHUs via ductwork. Air is exhausted from occupied spaces through ceiling mounted return vents connected to ductwork. The return vent ducts terminate in the wall of the AHU rooms (see Picture 2). Instead of installing ducts to connect the return vents to AHUs, the entire room was designed to serve as a return duct. The return air vent on each AHU is open to the room (see Picture 1). In this configuration, the AHU becomes depressurized which draws air from the return air ducts and in turn, the occupied spaces.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last servicing and balancing was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times when the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major

causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I.

Temperature readings ranged from 63° F to 68 ° F, which were below BEHA recommended comfort guidelines in all areas surveyed. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Temperature fluctuations in the building would be expected when conferences are in session.

The relative humidity ranged from 38 to 43 percent in occupied areas, which was close to the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Please note relative humidity in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Several different types of odors were reported by conference attendees. Upon entering the building, BEHA staff detected a distinct odor of used cooking oil was detected in the front foyer of the building. This odor indicates that the HVAC system is drawing air from the kitchen.

According to Mr. Duval, the kitchen had not been used for a period of time prior to the dates of the conference. The kitchen is a fully equipped commercial style kitchen, complete with a cafeteria-style serving area, a variety of cooking appliances, a dishwashing room and walk-in refrigerator. The ovens and other appliances are fueled with natural gas. In order to prevent kitchen odors from migrating into the function rooms and other areas, a large kitchen hood

exhaust vent system was installed over the oven and other cooking devices. If this exhaust vent were not operating, various odors present in the kitchen can then migrate into the function rooms. The following point sources of odor were identified in the kitchen:

1. A septic system odor and the smell of rotting food were detected around a sink (see Picture 3). A garbage disposal in the sink that had not reportedly been used for some time. It is likely that the trap within the disposal was dry, allowing for septic system odors to backup into the kitchen. In addition, food residue within the disposal itself likely decayed, producing the rotting food odor. Running water into the sinks drain and activating the garbage disposal for several minutes reduced/eliminated the odor.
2. A similar odor was detected in the dishwashing room from an inactive automated dishwasher. As this machine operates, odors and steam are vented by a duct system. When the automated dishwasher is deactivated, odors from food residue and the dry drain trap are not expelled from the building. In addition, the exterior lid covers of the automated dishwasher are covered with food (see Picture 4). Remaining food residue on these covers may also be a source of odor.
3. The front of the kitchen had a friolator with standing oil (see Picture 5). It is likely that the cooking oil odors are due to this source.
4. Cooking equipment had heavy residues(s). Areas underneath kitchen equipment were also heavily coated with dirt and cooking debris (see Pictures 6 through 8).
5. The ceiling and walls near the front of the kitchen were discolored with a heavy coating of cooking residue (see Picture 9 and 10).
6. The oven/stove is gas fueled with operating pilot lights. Products of gas combustion were detected around the oven/stove.

Each of these instances would produce odors that are consistent with reports made by conference attendees.

Sources of possible microbial contamination were noted in some areas of the building, but would not be expected to produce the symptoms described by conference attendees. Water damage was noted in a fire door vestibule located off the conference room. Water damaged gypsum wallboard (GW) clad with vinyl wallpaper was seen in this area. GW, wallpaper and wallpaper paste can serve as media for mold growth. The source of the water damage is likely the result of the design/configuration of the roof drainage system over the fire door. The DCC has a peaked roof. The roof is configured with one section above the level of another (see Picture 11). In order to provide rainwater drainage from the upper roof, a gutter and downspout was installed. The downspout empties directly on the lower roof and the roof wall junction. This is located directly over the water damage above the fire door. This configuration also allows the roof/exterior wall junction to become saturated, resulting in water penetration. Other damage to the roof system was noted (see Picture 12). A panel outside the kitchen was bent outwards, which may allow moisture to penetrate into the building. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous building materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If not dried within this time frame, mold growth may occur. Water-damaged porous materials (e.g. GW and carpeting) cannot be adequately cleaned to remove mold growth. The application of a mildewcide is not recommended.

Other Concerns

During the course of this investigation, it was revealed that repair work was conducted on the sprinkler system. This resulted in workers creating access holes through walls in the AHU

rooms to get to areas above the ceiling. A number of these access holes were not sealed (see Pictures 13 through 15). Since the AHUs are not connected to return vent ducts, the depressurization created by the draw of air by AHUs draws air from the ceiling plenum. While this condition may have some role in distributing irritating pollutants to occupied areas, the conditions noted in the kitchen are the most likely source of odors reported by conference attendees.

During the assessment it was also discovered that a squirrel had gotten into the suspended ceiling. A number of means of ingress through the exterior walls were identified (see Picture 16). In addition, MassDevelopment staff reported that the rear doors to the building are sometimes propped open by kitchen staff, which may be another entry route for pests. Rodent infestation can result in indoor air quality related symptoms due to materials in their wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in sensitive individuals (e.g. running nose or skin rashes). A three-step approach is necessary to eliminate rodent infestation:

1. removal of the rodents;
2. cleaning of waste products from the interior of the building; and
3. reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after rodents are eliminated (Burge, 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated. Under current Massachusetts law (effective November 1, 2001), the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000).

The bar area is reported to have had problems with sewer odors. Unused sinks and floor drains exist in this area. Drains are equipped with drain traps that form a water seal to prevent the backup of odors. Without water, the airtight seal on the trap can be breached; resulting in sewer gas backing up the drains and entering occupied areas. Sewer gas can create nuisance odors and be irritating to certain individuals.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Operate the kitchen exhaust vents during building occupancy regardless of kitchen operations.
2. Continue with plans to thoroughly clean the kitchen area to remove food residues from on and around kitchen appliances as well as building surfaces (e.g. walls and ceilings).
3. Use of integrated pest management (IPM) to rid the building of pest is highly recommended. A copy of the IPM recommendations can be obtained from the Massachusetts Department of Food and Agriculture (MDFA) website at the following website: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf. Activities that can be used to eliminate pest infestation may include the following activities.
    a. Rinse out recycled food containers. Seal recycled containers in a tight fitting lid to prevent rodent access;
    b. Remove non-food items that rodents are consuming;
    c. Stored foods in tight fitting containers;
    d. Clean crumbs and other food residues from ovens, toasters, toaster ovens, microwave ovens coffee pots and other food preparation equipment on a regular basis;

e. Examine each room and the exterior walls of the building for means of rodent egress and seal. Holes as small as ¼" are enough space for rodents to enter an area. If doors do not seal at the bottom, install a weather strip as a barrier to rodents; and

f. Reduce harborages (cardboard boxes) where rodents may reside (MDFA, 1996).

4. Seal breeches in the AHU walls made to repair sprinklers.

5. Reconfigure the gutter/downspout system to empty into the main roof gutter (Picture 11).

6. Repair the damage to the roof system (Picture 12).

7. Remove and replace any mold contaminated/water damaged GW and wallpaper. This measure will remove actively growing mold colonies that may be present. Remove mold contaminated materials in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001).

8. Seal drains in the bar that are not in use and pour water down those used regularly to prevent sewer gas back up.

9. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

10. For further building-wide evaluations and advice on maintaining public buildings, see the resource manual and other related indoor air quality documents located on the MDPH's website at http://www.state.ma.us/dph/beha/iaq/iaqhome.htm.

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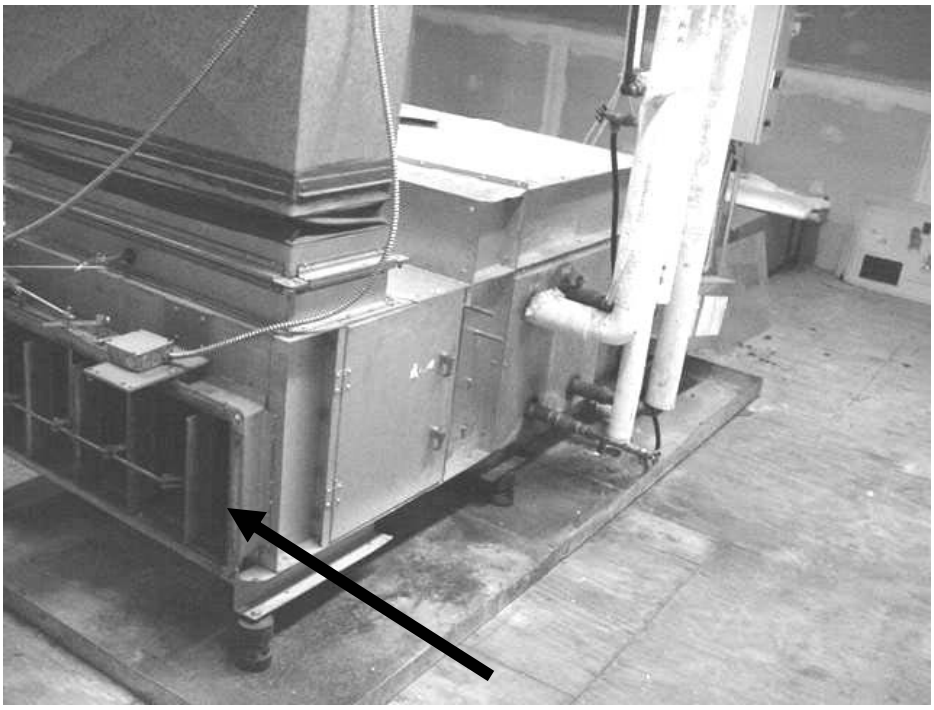
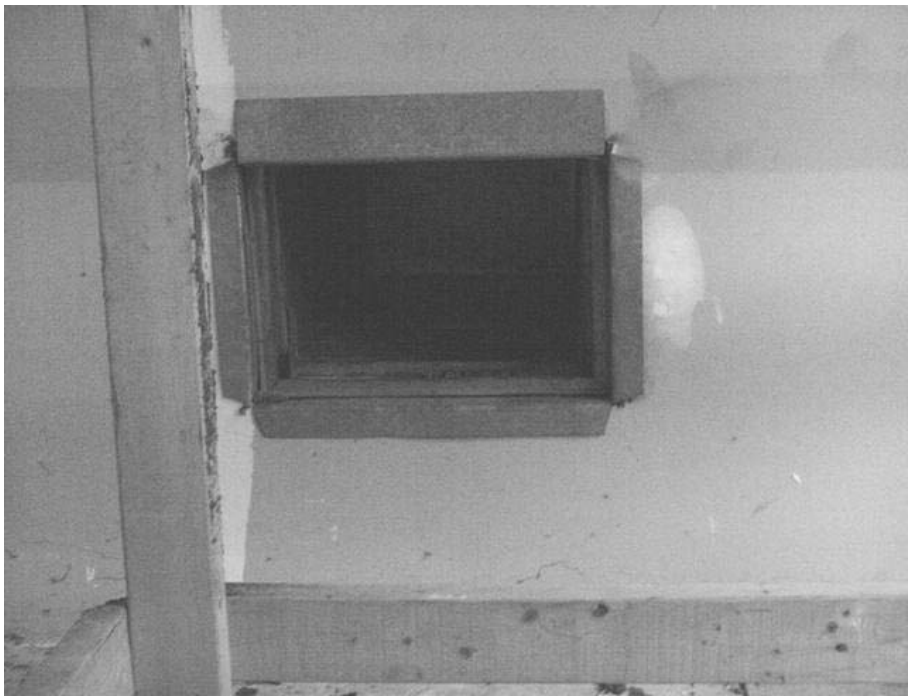
Picture 1



AHU Room, Note Open End of AHU

Picture 2



Return Vent Ducts Terminate in the Wall of the AHU Rooms

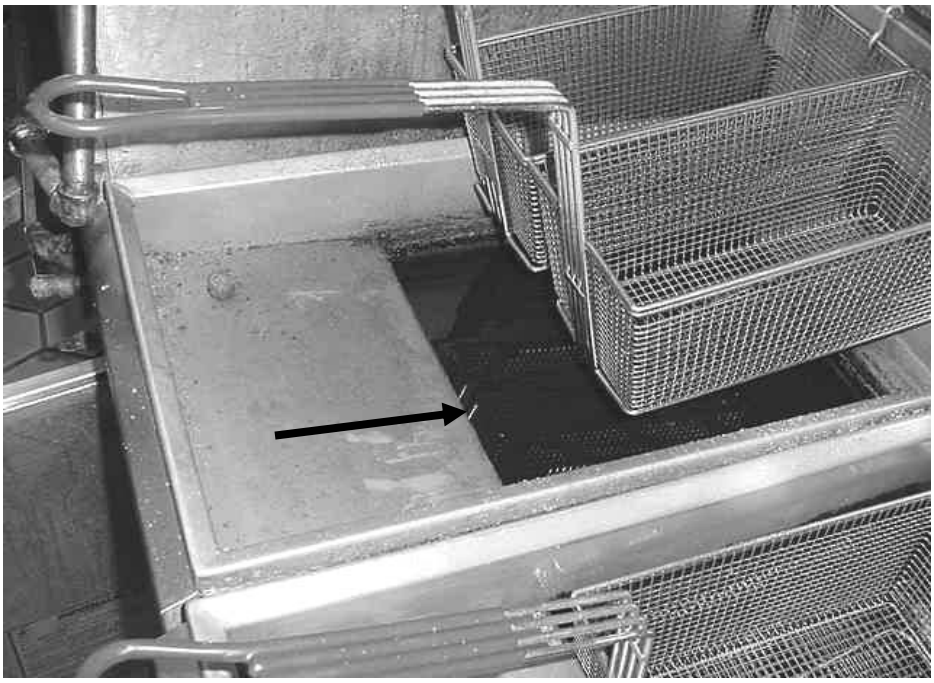
Picture 3

Garbage Disposal/Sink

Picture 4

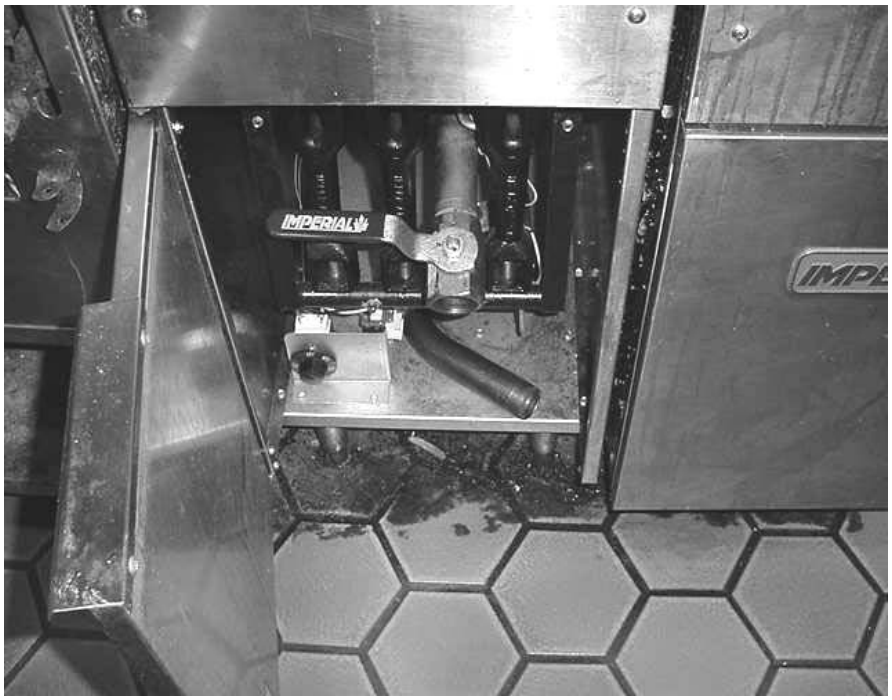
Automated Dishwasher, Note Containers Adhered to Cabinet

Picture 5



Friolator, Note Oil

Picture 6



Accumulated Residue beneath Kitchen Equipment

Picture 7

Accumulated Residue beneath Kitchen Equipment

Picture 8

Accumulated Residue beneath Kitchen Equipment

Picture 9

Ceiling Discolored in the Front Kitchen with a Heavy Coating of Cooking Residue, Note Color Difference in Ceiling Tiles

Picture 10

Ceiling Discolored in the Front Kitchen with a Heavy Coating of Cooking Residue, Note Color Difference in Ceiling Tiles

Picture 11

Gutter/Downspout System above Water Damage in Conference Room Fire Door Vestibule

Picture 12

Damage to Roof System outside Kitchen

Picture 13

Access Holes in GW of AHU Room

Picture 14

Access Holes in GW of AHU Room

Picture 15

Access Door in GW of AHU Room

TABLE 1

Indoor Air Test Results –Devens Conference Center, Devens, Massachusetts May 22, 2003

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Outside (Background)	420	0	56	62					Hornets nest Damaged flashing
Dining Room	425	0	63	43	0	N	Y	Y	
Board Room	434	0	63	43	0	N/A	Y	Y	
Conference Room	445	0	63	43	0	N/A	Y	Y	
Patio Room	510	0	63	43	0	N	Y	Y	
Kitchen Employee Lounge	560	0	65	43	0	N/A	Y		
Kitchen Fridge Area	590	0	65	42	0	N/A	Y		
Kitchen Main	512	0	66	41	0	N/A	Y		
Kitchen Dishwashing	560	0	67	43	0	N/A	Y	N	Fruit flies
Kitchen Glass storage	443	0	67	41	0	N/A	Y	N	
Kitchen Server	510	0	65	39	0	N/A	Y	Y	

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

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							Supply	Exhaust	
Bull's Eye Eatery	534	0	68	38	0	N	Y	Y	
Manager's Office	705	0	68	38	1	N/A	Y	N	1 ajar ceiling tile Door open
Office	560	0	67	38	2	N	Y	Y	3 ceiling tiles water-damaged Door open
Innovations Hall	438	0	65	38	0	N	Y	Y	10 ceiling tiles water-damaged Interior door open Water entry by exterior doorway
Hallway Outside Bulls Eye									4 ceiling tiles water-damaged
Foyer									5 ceiling tiles water-damaged

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